

This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2010	2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010		
4. TITLE AND SUBTITLE Abdominal Compartment Syndrome After Hip Arthroscopy			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Keller Army Hospital,Orthopaedic Surgery,West Point,NY,10996			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT see report					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Case Report

Abdominal Compartment Syndrome After Hip Arthroscopy

Justin Fowler, M.D., and Brett D. Owens, M.D.

Abstract: As hip arthroscopy becomes a more common procedure, more complications may occur. We present a case of abdominal compartment syndrome resulting from fluid extravasation in a 42-year-old man who underwent routine hip arthroscopy for femoral acetabular impingement. He had not had previous surgeries to that hip, and arthroscopy was performed in the supine position. After adequate distraction, arthroscopy was performed with an automated pressure- and flow-controlled pump with the pressure maintained between 40 and 60 mm Hg. We performed debridement of a degenerative tear of the anterosuperior labrum, removal of a pincer lesion, and a psoas tenotomy through a capsular window. A distended abdomen was noted on drape removal, and the patient required decompressive laparotomy for abdominal compartment syndrome. Extravasation of arthroscopy fluid is a potentially devastating complication during hip arthroscopy, and there should be careful monitoring by the surgeons, anesthesiologists, and operating room staff.

Hip arthroscopy is growing in popularity for the treatment of femoroacetabular impingement. Published reports suggest that the overall rate of complications is less than 1.5% and that hip arthroscopy is a relatively safe procedure. Common complications include pudendal nerve palsy, chronic hip instability, inadequate debridement, and rarely, femoral neck fracture (Table 1).¹ However, as the use of this procedure increases, more complications have been reported recently. We present a case of abdominal compartment syndrome after hip arthroscopy for femoroacetabular impingement.

CASE PRESENTATION

A 42-year-old man, an active-duty service member, with no significant medical or surgical history presented to our institution with a long-standing history of right hip and groin pain that was refractory to conservative management. He complained of pain while sitting and had difficulty putting on his boots. He also complained of intermittent audible snapping in his groin that was associated with pain. On physical examination, he had a positive impingement sign with pain in the flexed and internally rotated position. He also had audible snapping in his groin when taken from a flexed, externally rotated position to an extended and internally rotated position. Radiographs showed a crossover sign suggestive of pincer-type femoral acetabular impingement of the right hip, and a magnetic resonance imaging arthrogram showed a degenerative tear of his anterosuperior labrum. The patient did report symptomatic relief with an intra-articular injection. He was offered hip arthroscopy with pincer decompression, labral debridement, and psoas tenotomy.

Arthroscopy was performed with the patient in the lateral position with distraction over a well-

From the Division of Orthopaedic Surgery, William Beaumont Army Medical Center, El Paso, Texas, U.S.A.

The views and opinions expressed in this manuscript are those of the author(s) and do not reflect the official policy of the Department of the Army, the Department of Defense, or the U.S. Government.

Address correspondence and reprint requests to Brett D. Owens, M.D., Orthopaedic Surgery, Keller Army Hospital, West Point, NY 10996, U.S.A. E-mail: b.owens@us.army.mil

Published by Elsevier Inc. on behalf of the Arthroscopy Association of North America

0749-8063/10/2601-9277\$0.00/0

doi:10.1016/j.arthro.2009.06.021

TABLE 1. *Reported Complications of Hip Arthroscopy*

Major Complications	Minor Complications
Retroperitoneal/intraperitoneal extravasation ⁴	Lateral femoral cutaneous neurapraxia
Septic arthritis ⁷	Pudendal nerve compression
Pulmonary embolism ⁸	Sciatic neurapraxia ⁹
	Instrument breakage ⁷

padded perineal post. Under fluoroscopic guidance and needle localization, an anterior paratrochanteric portal was made, and the arthroscope was introduced into the hip joint. An accessory anterolateral portal was then created, and a cannula was placed to provide outflow. An arthroscopic pump with inflow monitoring and outflow was used with the pump pressure set to 40 mm Hg. Intermittent lavage was performed with the pressure- and flow-controlled pump (FMS Duo; Mitek, Raynham, MA), which raised the pressure to 60 mm Hg for 2 minutes. Diagnostic arthroscopy showed intact articular surfaces of the femoral acetabular joint and a large overhanging pincer-type lesion, as well as degeneration of the anterior labrum. A capsular window was made to expose the psoas tendon (Fig 1). The psoas tendon was then cut, and we began our debridement of the anterior and superior labrum and

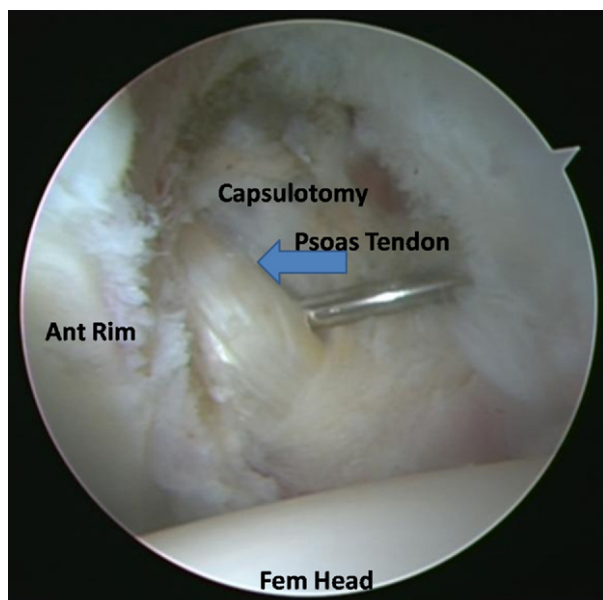


FIGURE 1. Right hip in supine position with arthroscope in anterior paratrochanteric portal: The probe is behind the psoas tendon visible through an anterior capsulotomy. (Ant, anterior; Fem, femoral.)

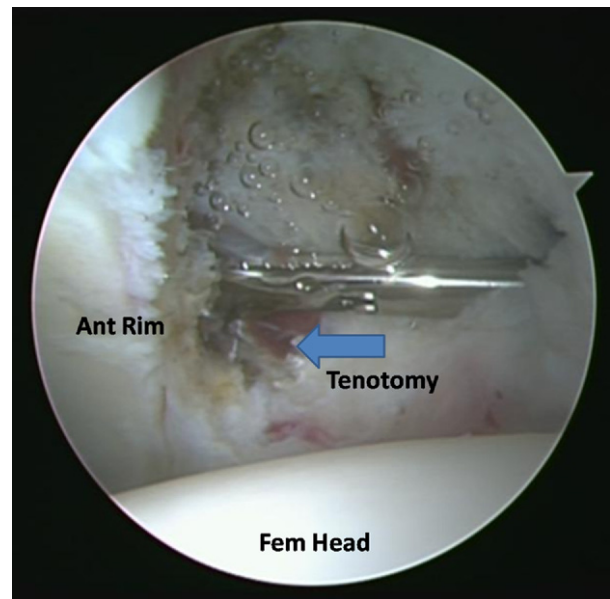


FIGURE 2. An arthroscopic biter is used to perform the psoas tenotomy. (Ant, anterior; Fem, femoral.)

pincer-type lesion (Fig 2). The total operating time was 95 minutes, and the patient received 800 mL of lactated Ringer solution with minimal blood loss. His core body temperature remained steady throughout the procedure.

The draping was subsequently removed, and we observed that the patient's abdomen was extremely distended. The general surgery team was consulted and noted elevated bladder pressures (42 mm Hg), as well as an increased peak inspiratory pressure, thus preventing extubation. Abdominal compartment syndrome was diagnosed, and a diagnostic peritoneal lavage was attempted and failed. An emergent exploratory laparotomy was performed, which yielded 1,200 mL of serosanguinous fluid within the abdominal cavity. The retroperitoneum was noted to be distended and boggy with an obvious fluid track along the iliopsoas muscle and iliac vessels on the right side. The abdomen was left open, and a wound vacuum was placed. A staged primary closure of the patient's abdomen was performed on postoperative day 3. He was discharged 3 days later in stable condition, and he reported noticeable improvement of his hip impingement. At his most recent follow-up, he is asymptomatic in his right hip and groin but is continuing follow-up by a general surgeon for abdominal complaints related to his incision and abdominal compartment syndrome.

DISCUSSION

This case of abdominal compartment syndrome is concerning. There are two previous reports of this complication, one of which occurred during elective surgery. Bartlett et al.² reported this event after performing hip arthroscopy for loose-body removal in a patient who sustained an acetabular fracture of both columns and was treated with open reduction-internal fixation through an ilioinguinal approach. The fluid extravasation resulted in an intraoperative cardiac event and death. They concluded that ipsilateral acetabular fracture is a contraindication for arthroscopy. Haupt et al.³ reported the case of a 15-year-old girl who underwent hip arthroscopy for adhesiolysis after a previous surgical dislocation of the hip for treatment of femoral acetabular impingement. The operation was performed without complications aside from the anesthesiologist noting a decrease in core body temperature. On waking from surgery, the patient reported abdominal distension and discomfort. Abdominal ultrasound showed 2 to 3 L of intraperitoneal and retroperitoneal fluid that was thought to be irrigation fluid. The patient was closely monitored, and her symptoms resolved within 24 hours of surgery. The authors concluded that a sudden decrease in core body temperature is highly suggestive of extravasation of irrigation fluid and should be investigated.

A similar case report was recently published suggesting that, although this complication remains rare, an increase may be seen that reflects the increased performance of hip arthroscopy. Sharma et al.⁴ reported a case of retroperitoneal and intraperitoneal extravasation during a similar hip arthroscopy with psoas tenotomy through a capsular window. The patient had a precipitous decrease in blood pressure and required emergent laparotomy, which showed intra-abdominal fluid. The proposed mechanism of extravasation was similar to that in our case.

The term "abdominal compartment syndrome" was first introduced in 1989.⁵ It is defined as an intra-abdominal pressure of greater than 20 mm Hg measured directly with an intra-abdominal pressure monitor.⁶ Abdominal compartment syndrome poses a great risk to end organs and can cause many systemic complications. Much like compartment syndrome in an extremity, the diagnosis of abdominal compartment syndrome is a clinical diagnosis because many institutions do not use real-time abdominal pressure monitoring. Systemic manifestations of abdominal compartment syndrome in the acute setting include abdominal pain and distension, decreased urine out-

put, increased bladder pressures, and increased peak inspiratory pressure. Laparotomy and abdominal decompression with delayed closure should be performed emergently for suspected cases.⁶

In our case no fracture was present and no sudden decrease in core body temperature was noted intraoperatively. We hypothesize that our capsulotomy and subsequent psoas tenotomy allowed decreased resistance for irrigation fluid to extravasate into the retroperitoneum and eventually into the abdominal cavity. This did not manifest itself until after the case when the draping was removed and the patient's abdomen was noticeably distended and it became increasingly difficult to ventilate the patient. Emergent decompression was performed by our general surgical colleagues, and despite their rapid decompression, the patient still has abdominal complaints related to his compartment syndrome. However, severe end-organ damage was avoided.

This case illustrates the need for physicians and support staff to be aware of the amount of fluid being used in any arthroscopy case. Physical and physiologic signs of fluid extravasation should be monitored throughout the entire procedure. This experience has led us to alter our order of surgical procedures, saving the capsulotomy and psoas tenotomy until the end of the central compartment arthroscopy, to minimize the risk of fluid extravasation.

REFERENCES

1. Ilizaliturri VM Jr. Complications of arthroscopic femoroacetabular impingement treatment: A review. *Clin Orthop Relat Res* 2009;467:760-768.
2. Bartlett CS, DiFelice GS, Buly RL, Quinn TJ, Green DS, Helfet DL. Cardiac arrest as a result of intraabdominal extravasation of fluid during arthroscopic removal of a loose body from the hip joint of a patient with an acetabular fracture. *J Orthop Trauma* 1998;12:294-299.
3. Haupt U, Volkle D, Waldherr C, Beck M. Intra- and retroperitoneal irrigation liquid after arthroscopy of the hip joint. *Arthroscopy* 2008;24:966-968.
4. Sharma A, Sachdev H, Gomillion M. Abdominal compartment syndrome during hip arthroscopy. *Anaesthesia* 2009;64:567-569.
5. Fietsam R Jr, Villalba M, Glover JL, Clark K. Intra-abdominal compartment syndrome as a complication of ruptured abdominal aortic aneurysm repair. *Am Surg* 1989;55:396-402.
6. Sugrue M, Buhkari Y. Intra-abdominal pressure and abdominal compartment syndrome in acute general surgery. *World J Surg* 2009;33:1123-1127.
7. Clarke MT, Arora A, Villar RN. Hip arthroscopy: Complications in 1054 cases. *Clin Orthop Relat Res* 2003;8488.
8. Bushnell BD, Dahners LE. Fatal pulmonary embolism in a polytraumatized patient following hip arthroscopy. *Orthopedics* 2009;32:56.
9. Lo YP, Chan YS, Lien LC, Lee MS, Hsu KY, Shih CH. Complications of hip arthroscopy: Analysis of seventy three cases. *Chang Gung Med J* 2006;29:86-92.